UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

RESIT EXAMINATION 2021

Title: TELECOMMUNICATIONS AND WIRELESS SYSTEMS

Course Code: EEE541

Time Allowed: THREE (3) HOURS

Instructions:

1. Answer any **four (4)** questions
2. Each question carries **25** marks

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This paper consists of four (4) pages

QUESTION 1

(a) What is the difference between FDMA and FDM [3].

(b) Consider the transmitting antenna of a geostationary satellite fed with a power P_T of 10 W, that is, 10 dBW at a frequency $f_D = 12$ GHz ($f_U = 14$ GHz), and radiating this power in a beam of width $\theta_{3\text{dB}}$ equal to 2°. An earth station equipped with a 4 m diameter antenna is located on the axis of the antenna at a distance of 40000 km from the satellite. The efficiency of the satellite antenna is assumed to be $\eta = 0.55$ and that of the earth station to be $\eta = 0.6$. Find the received power [7].

(c) Discuss the IS-95 reverse transmission system [10].

(d) Describe the three ways of performing handoff in mobile networks [5].

QUESTION 2

(a)Discuss the following terms: *location management, packet delivery to mobiles, handoff and roaming* [8].

(b) Figure 1 shows the geometry of the uplink. It is assumed that the transmitting earth station is on the edge of the 3 dB coverage of the satellite receiving antenna. Calculate $(C/N_0)_U$ [10].

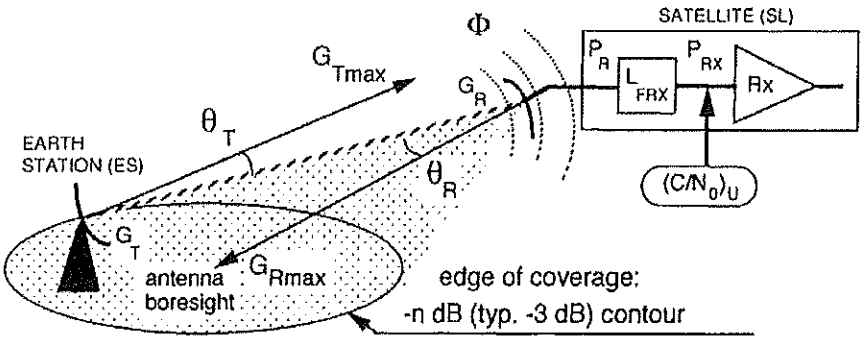

Fig. 1: The geometry of an uplink.

The data are as follows:

- Frequency f_U = 14 GHz
- For the earth station (ES):
  - Transmitting amplifier power: $P_{TX} = 100$ W
  - Loss between amplifier and antenna: $L_{FTX} = 0.5dB$
  - Antenna diameter: $D = 4$ m
  - Antenna efficiency: $\eta = 0.6$
  - Maximum pointing error: $\theta_T 0.1°$
- Earth station - satellite distance: $R = 40000$ km
- Atmospheric attenuation: $L_A = 0.3$ dB (typical value for attenuation by atmospheric gases at this frequency for an elevation angle of 10°)
- For the satellite (SL):
  - Receiving beam half power angular width: $\theta_{3\text{dB}} = 2°$
  - Antenna efficiency: $\eta = 0.55$
  - Receiver noise figure: $F = 3$ dB
  - Loss between antenna and receiver: $L_{FRX} = 1$ dB
  - Thermodynamic temperature of the connection: $T_F = 290$ K
  - Antenna noise temperature: $T_A = 290$ K

(c) A step-index fiber has a core index of refraction of $n_1 = 1.425$. The cut-off angle for light entering the fiber from air is found to be 8.50°. (i) What is the numerical aperture of the fiber? (ii) What is the index of refraction of the cladding of this fiber? (iii) If the fiber were submersed in water, what would be the new numerical aperture and cut-off angle? [6]

(d) Differentiate between a home agent and foreign agent [1].

QUESTION 3

(a) State the features of TDMA [5].

(b) Discuss the basic communication mechanism of a wavelength-routed network [10].

(c) State and describe the cache invalidation schemes [6].

(d) What are the elements that make up the satellite system [4].

QUESTION 4

(a) Discuss the multicarrier technologies that are used in LTE for uplink and downlink transmission [4].

(b) Discuss the closed-loop automatic tracking systems for satellite communications [8].

(c) Mobility can take different forms. State and discuss each one [6].

(d) What is scrambling. Discuss how a scrambler and descrambler works [7].

QUESTION 5

(a) Draw the EPS architecture and state the function of each element [10].

(b) Determine the angle of tilt required for polar mount used with a earth station at latitude 49° N. Assume a spherical earth of mean radius 6371 km, and ignore the earth station latitude [4].

(c) State and discuss the location update strategies [11].